PATENT SPECIFICATION

DRAWINGS ATTACHED

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Improvements relating to covered belts and method for manufacturing same.

COMPLETE SPECIFICATION

We, DAYCO CORPORATION, formerly named The Dayton Rubber Company, of 2342, Riverview Avenue, Dayton 1, Ohio, United States of America, a Corporation organized under the laws of the State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates to belting and particularly to power transmission belting which includes an outer protective wrapper or cover on one or more of its surfaces, and to a method of manufacture of such belting.

In the art of belting, particulary power transmission belting, wherein the belts are exposed to oil, grease, sunlight and other deteriorating elements as well as to the severe structural demands of power transmission, it has been desired in many cases to provide a protective cover, usually of fabric impregnated or coated with a rubber or elastomeric material, about the core of the belt. As is well known to those skilled in the art, it is of extreme importance that power transmission belts, which constantly flex as they pass around sheaves or pulleys only to straighten out upon coursing the distance therebetween, be made as flexible as possible in order that this constant flexing and straightening will not create excessive heat or otherwise result in excessive wear. As is also well known to those familiar with the power transmission belting art, the provision of the otherwise desired covers or protective layers necessarily involves a decrease in belt flexibility.

In order to reduce as much as possible the stiffening of the belt as a result of the presence of covers or wrappers thereon, it has become a common practice to form the covers of a fabric which has been cut in separate widths diagonally of a fabric web, the warp and weft threads of which are at right angles. When such a web, the complementary woven threads of which intersect at right angles, is cut into individual widths along lines at an angle, usually 45 degrees or thereabouts, to the threads, the individual widths are then applied to the belts longitudinally thereof so that, everything else being equal, the angle of intersection of the threads in the finished belt with the longitudinal axis of the belt would be approximately 45 degrees. As a result of this angular disposition of the threads, it has developed that the individual threads do not present the full effect of their substantial inextensibility to the normal flexing of the belt and when the belt does flex, the threads are merely displaced from their normal angular relationship so as to render the angle of their intersection with the longitudinal axis less than the 45 degrees at which they normally lie thereto. While the previously employed angle of cutting of the original fabric web and the resulting angle of the intersection of the threads in the belt with the longitudinal axis thereof has been in the neighborhood of 45 degrees, it has been found that an even larger angle of intersection, say 50 or 55 degrees, of the threads with the longitudinal axis of the belt will provide slit greater flexibility in that the angularly disposed threads may be pulled still further out of their normal angular relationship before they exert their inextensible influence upon the extension of the belt which must attend its flexing.

It has therefore developed that although the original bias cutting of the web of fabric having its complementary threads intersecting at right angles has resulted in some improvement in the flexibility of belts, the maximum possible effect of such cutting has been lost due to the fact that under tensile stress, the individual threads have been displaced from their desired right-angle rela-

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tionship so that they open in an acute angle longitudinally of the belt and consequently, the angle of intersection of any of the threads with the longitudinal axis of the belt is less than 45 degrees. As this angle is reduced, the result has been that the ability of the cover material to stretch and the otherwise obtainable gain in flexibility from the use of the bias-cut fabric will be lost in the finished belt.

It is accordingly an object of the present invention to provide a novel method of making improved belting of the type set forth in the preceding paragraphs.

According to the present invention, a method of making a power transmission belt includes the steps of continuously applying and bonding a fabric cover layer of bias cut woven material to at least one surface of a pre-formed belt-core of reinforced natural or synthetic elastomeric material whilst said surface is subjected to tensile stress by flexing successive portions of the core in a continuous manner whereby the warp and weft threads of the cross-woven fabric cover layer so applied intersect each other at an abtuse angle presented towards the longitudinal axis of the core when the belt is in its unstressed condition.

Preferably, the flexing of the belt core is performed by passing it around a pulley, sheave or the like, and the fabric, of which the warp and weft threads may intersect initially at an angle of substantially 90°, is applied to the outer surface of the belt core at the centre of the flexed portion passing around the pulley, sheave or the like.

More specifically, while employing the conventionally used bias-cut cover fabric widths as cover for the belt core, it is suggested according to the present invention, to apply these widths to the belt in such a manner that instead of reducing the angle of intersection of the threads presented towards the longitudinal axis of the belt, such angle will actually be increased in the normal unstressed condition of the belt and made greater than the original angle of intersection.

Therefore, if, in accordance with the invention, bias-cut cover fabric widths with complementary warp and weft threads intersecting at right angles are applied to the belt core at a time and at the point at which it is in a condition of the greatest flexure which it will achieve during its actual operation, the desired 90 degree angular relationship of the complementary threads will exist at this point of flexure but when the belt straightens out or returns from such flexed position, the angular relationship of the fabric threads will actually be increased.

In conventionally used V-Belts or power transmission belts of trapezoidal or truncated triangular cross section, the belts are normally of a substantial thickness. With such belts, it is obvious that the greatest extension of the belt or the cover thereon will be required at that surface thereof which is away from the direction of flexure, that is, the outer surface.

The invention is illustrated by way of example in the accompanying drawings in which:

Fig. 1 is a fragmentary plan view of a typical power transmission belt incorporating a fabric cover and made according to the present invention.

Fig. 2 is a cross section on line 2—2 of Fig. 1 showing generally the relationship of the fabric cover to the power transmission belt core.

Fig. 3 is a plan view of a typical fabric web from which bias-cut cover widths used in carrying out this invention may be cut.

Fig. 4 is a plan view of an individual bias-cut cover width formed from the web shown in Fig. 3.

Fig. 5 is a schematic illustration in elevation showing one preferred manner and apparatus for applying the cover width such as shown in Fig. 4 to a belt core.

Referring now to Figs. 1 and 2 a typical belt of the type considered by the present invention comprises a belt core 10 consisting of a strength portion 11 of a flexible but inextensible material such as textile cords, wire cables or the like embedded in a body of elastomeric material, that portion 12 which is below the strength portion being generally referred to as the compression section, while the portion 13 above the strength portion is being referred to as the tension section. These terms are derived from the fact that the strength portion 11 is normally placed at the theoretical axis transversely of the belt about which it flexes with the result that that porion of the belt inwardly thereof or below the cord line 11 is under compression while the portion exteriorly thereof is under tension. In certain of the power transmission belts, fabric components may be incorporated either in the compression or tension section of the belt to give added strength and rigidity. It is this core of the belt which provides the power transmission strength thereof and it is this core which is sought to be protected by the application of the cover designated generally by the number 14.

In conventional belts, the cover 14 consists of a cross-woven fabric, usually bias-cut, as explained above and applied so that the complementary threads thereof form an angle of approximately 90 degrees with each other or 45 degrees with the longitudinal axis of the belt, the fabric normally being impregnated and/or coated with a layer of rubber, synthetic rubber or similar elastomeric plastic material.

Referring to Fig. 3, the cover material normally begins in the form of a web 15 of cross-woven fabric having transversely extending weft or fill threads 16 and longitudinally extending warp threads 17, the warp and weft threads intersecting at right angles. Such a web is substantially inextensible insofar as the inextensibility of the warp threads 17 persent their full effect to the stretching longitudinally of the web while the inextensible fill threads 16 provide a similar inextensible influence upon stretching transversely of the web. In view of the fact that the web at this stage is, therefore, substantially inextensible in either direction, it may be conveniently handled and passed through calendering rolls and the like wherein the rubber or similar elastomeric material is applied thereto. Once the web 15 has passed through the calendering rolls or other severe handling it may then be cut for example along the diagonal or biased lines 18 and 19 to form the individual width 20 therefrom. Such a width 20 is shown in Fig. 4 as it would be removed from the web of Fig. 3. Viewing this web and comparing the same with the position thereof in the web 15 of Fig. 3 it will be seen that the warp threads 17 still intersect the weft threads 16 at right angle; but, in view of the fact that the web has been cut on lines at an angle, say 45 degrees, to the edges or longitudinal axis of the web, the threads 16 and 17 no longer extend longitudinally of and transversely of the strip 20. Rather do these threads intersect the edges 21 or the longitudinal axis 22 of the strip at an angle corresponding to the angle with the edges of the web 15 of the lines 18 or 19 along which they were cut. It can be seen that if this strip so cut were applied longitudinally of a belt, the threads 16 and 17 would make an angle with the longitudinal axis of the belt equal to their angle with the longitudinal axis 22 of the strip as shown in Fig. 4, which as explained above is also equal to the angle which the lines 18 and 19, upon which such strip was cut, made with the longitudinal axis of the original web. If such angular relationship of the threads is established in the final belt it will also be understood that the strip will be extensible to a limited extent as a result of the fact that the angular relationship of the threads may be displaced upon the application of a stretching force to the strip before the inextensibility of the threads will operate to limit the stretching. It will also be apparent however, that as the angular relationship of the thread is affected so that the angle of intersection presented towards the longitudinal axis of strip is reduced more and more, the inextensible nature of all of the therads will be more nearly aligned with the direction of the stretching force such that the threads will begin to retard the stretchability and as a result will limit the free flexibility of a belt about which such a strip is applied. It will also be apparent on the other hand from examination of Fig. 4 that if the angle of cross threads with the longitudinal axis of the belt were increased from say the 45 degrees now shown to 50 or 55 degrees, or if the angle of intersection of the threads were altered so that they no longer intersected at right angles but rather intersected at such an angle that the angles opening longitudinally of the belts were obtuse or greater than 90 degrees, greater extensibility would be obtained in view of the fact that the belt could be stretched further before the individual threads would be displaced to the extent that their threads would be aligned sufficiently with the direction of the application of the stretching force to prevent further stretching. This desired angular relationship of the individual threads of the fabric to the longitudinal axis of the belt is shown in Fig. 1, wherein the longitudinal axis 23 of the belt is intersected by the threads 16a and 17a at an angle which is greater than 45 degrees or, stated otherwise, wherein the thread themselves intersect each other at an angle which is considerably greater than the original 90 degrees.

In order to achieve this desired angular relationship of the threads of the woven fabric in the finished belt, applicants have developed a method and apparatus for specially handling this fabric width such as 20 of Figs. 3 and 4. This apparatus consists generally of a means for applying the cover material similar to the strip 20 in Figs. 3 and 4 to a belt core 25 similar to 10 of Fig. 2. The means for supplying the covering material 24 may consist simply of a train of rollers, pulleys or sheaves 26, 27 and 28 which merely convey the material from a feed roll 28a to the point of its application.

It can be seen from Fig. 5 that the belt core 25 is placed in a position approximating that in which it will be operated, this position being simulated by the provision of sheaves or pulleys 29 and 30 similar to those upon which the finished belt will actually operate. In the case of a trapezoidal V-type belt as shown in Fig. 2 for example, the sheaves 29 and 30 would simply be V-groove pulleys. One of the sheaves or pulleys 29 and 30 is provided with a driving mechanism of any standard type (not shown) such that the belt core 25 will be set in rotation. The mechanism for driving either one of the pulleys 29 or 30 will also be linked with a driving mechanism for the feeder rolls or pulleys such as 26, 27, 28 and 28*a* so that the peripheral speed of the belt core 25 and the rate of travel of the cover material 24 will be substantially equal and no stretching of the material will result as it is pulled from

the conveying assembly. On the other hand the greatest advantage resulting from the present invention may be obtained if in fact the peripheral speed of the belt core 25 is slightly less than the rate of feed of the cover 24 so that the cover is slightly compressed longitudinally as it is applied to the belt core. The cover material 24 is applied to the belt core 25 at the centre of the flexed portion passing around the pulley 30 and preferably, the size of this pulley is chosen so that the flexure at this point approximates to the greatest flexure which the belt will undergo during use. As shown, the pulley or wheel 28 may be pivoted upon a shaft such as 31 which may be spring loaded, or said pulley may be otherwise adjustably forced against the belt core 25 while it is in travel. If the fabric web 24 is fed on to the core 25 at the point where the roller 28 is forced against the core, it will be appreciated that the cover material can be pressed firmly against the core notwithstanding the fact that both are in motion. Either at this point or sometime prior to the actual bringing of the cover material and belt core to the covering operation, the respective surfaces of these components to come in contact may be made tacky. In the case of conventionally employed rubber or synthetic rubber coated or impregnated fabric, and the conventional vulcanizable elastomeric belt cores, the elastomeric material may be compounded in its original stages to possess sufficient building tack to enable the cover to be firmly secured to the core without the use of any additional adhesives or cements. Since such provision, no matter how made, results in the firm sticking or bonding of the cover to the core, the cover will no longer be in its freely flexible state and the individual threads thereof may be much less readily displaced. As a result the angle of the intersection of the complementary threads of the cover fabric is permanently established at the point where it is applied to the core. It has been found however, that once the core passes on around the pulley for example 29 and straightens out or once the belt is removed from the pulleys altogether and assumes its normally unstressed circular configuration not affected by the presence of the pulleys, the threads will be forced in a manner which will cause the angle of their intersection longitudinally of the belt to spread or open so as to be greater than that at which they were first applied to the belt. Where, as explained above, the belt being covered according to the method of the present invention is a V-Belt or other power transmission belt of considerable thickness, it follows that the greatest extensibility thereof will be required on that surface thereof which is away from the direction of flexure, and accordingly, in order to obtain the greatest advantages it is preferred that this cover strip 24 be applied to the outer surface of the belt core which is subjected to the greatest tension during flexure of the belt.

While for the sake of clarity the showing of Fig. 5 involves only the application of the covering material to the top or outermost surface of the core, it will be understood that a wide strip of the cover fabric so applied may be wrapped around the other sides of the core if desired by the use of additional rollers and guides according to well-known methods and procedures.

In the case of typical belts composed of rubber, synthetic rubber or other vulcanizable elastomeric compositions, the wrapped or covered core is placed under heat or pressure, usually in a press or a mold and vulcanized whereupon an integrated product is obtained and the desired conditions of the cover derived according to the above are maintained.

WHAT WE CLAIM IS:

1. A method of making a power transmission belt which includes the steps of continuously applying and bonding a fabric cover layer of bias-cut cross-woven material to at least one surface of a pre-formed belt core of reinforced natural or synthetic elastomeric material whilst said surface is subjected to tensile stress by flexing successive portions of the core in a continuous manner whereby the warp and weft threads of the cross-woven fabric cover layer so applied intersect each other at an obtuse angle presented towards the longitudinal axis of the core when the belt is in its unstressed condition.

2. A method, as claimed in claim 1, in which the warp and weft threads of the fabric cover layer applied to the belt core initially intersect each other at an angle of substantially 90°.

3. A method, as claimed in claim 1 or 2, in which the flexing is carried out by passing the core belt around a pulley, sheave, or the like.

4. A method, as claimed in claim 3, in which the fabric cover layer is applied to the outer surface of the belt core at the centre of the flexed portion passing around the pulley sheave, or the like.

5. A method as claimed in any of the preceding claims in which the fabric cover layer is impregnated with a tacky elastomeric vulcanizable composition before application to the belt core.

6. A method, as claimed in claim 5, in which the fabric cover layer is applied under pressure to the surface of the belt core, the parts thus assembled thereafter being vulcanized.

7. A power transmission belt comprising a core of reinforced natural or synthetic

elastomeric material and a cover layer of cross-woven fabric material the warp and weft threads of which intersect each other at an obtuse angle presented towards the longitudinal axis of the core when the belt is in an unstressed condition, said belt being made by the method claimed in any one of the preceding claims.

8. A method of making a power transmission belt substantially as herein described with reference to the accompanying drawing.

9. A power transmission belt made substantially as herein described with reference to the accompanying drawing.

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FIG. 2

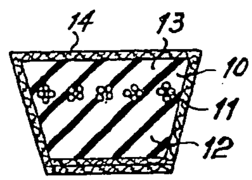

FIG. 1

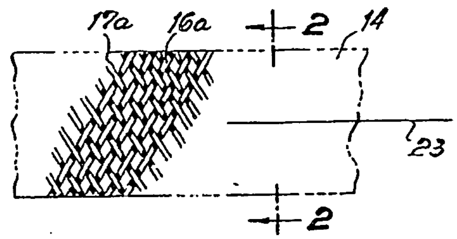

FIG. 3

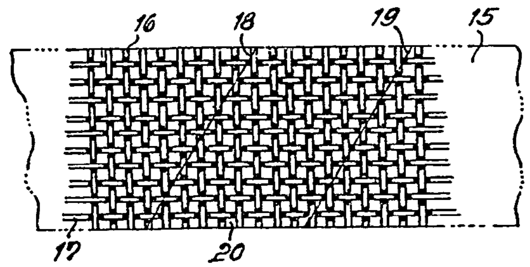

FIG. 4

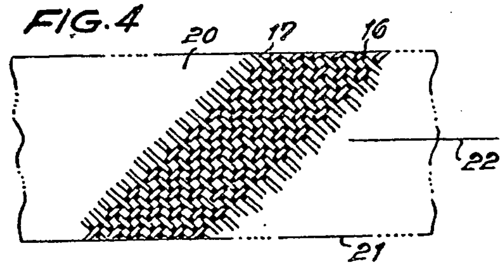

FIG. 5